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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Peter Lam
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025-1026

EXAMINER

LI, AIMEE J

ART UNIT	PAPER NUMBER
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2183

DATE MAILED: 10/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/039,588

Applicant(s)

SAGER ET AL.

Examiner

Aimee J Li

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 December 2001 and 15 April 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1, 4-9, 17-18, and 24-25 is/are rejected.
- 7) ☒ Claim(s) 2,3,10-16,19-23,26 and 27 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 December 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892) *
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

DETAILED ACTION

1. Claims 1-27 have been considered.

Papers Submitted

2. It is hereby acknowledged that the following papers have been received and placed of record in the file: Oath and Declaration as filed on 15 April 2002.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: Figures 1 and 2, elements 22, 36, and 37; Figure 2, element 32; and Figure 4, element 428. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use. The applicant lacks a "Brief summary of the invention" in applicant's current specification.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

- (a) TITLE OF THE INVENTION.
- (b) CROSS-REFERENCE TO RELATED APPLICATIONS.
- (c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
- (d) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC (See 37 CFR 1.52(e)(5) and MPEP 608.05. Computer program listings (37 CFR 1.96(c)), "Sequence Listings" (37 CFR 1.821(c)), and tables having more than 50 pages of text are permitted to be submitted on compact discs.) or
REFERENCE TO A "MICROFICHE APPENDIX" (See MPEP § 608.05(a). "Microfiche Appendices" were accepted by the Office until March 1, 2001.)
- (e) BACKGROUND OF THE INVENTION.
 - (1) Field of the Invention.
 - (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (f) BRIEF SUMMARY OF THE INVENTION.
- (g) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
- (h) DETAILED DESCRIPTION OF THE INVENTION.
- (i) CLAIM OR CLAIMS (commencing on a separate sheet).
- (j) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
- (k) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

5. The disclosure is objected to because of the following informalities: Please review the entire specification for grammatical errors. Examples are

- a. On page 2, paragraph 003, line 3, please correct "The pipeline comprises of several stages..." to read --The pipeline comprises [[of]] several stages...--.
- b. On page 4, paragraph 007, line 1, please correct "**Figure 1** is block diagram..." to read --**Figure 1** is a block diagram..."

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- c. On page 5, paragraph 0011, line 10, please correct "...multiple levels of replay mechanism *is* needed." To read --...multiple levels of replay mechanism [[is]] are needed.--
 - d. On page 11, paragraph 0032, line 3, please correct "...or have executed before *is* gone." To read --...or have executed before [[is]] are gone.--
6. Appropriate correction is required.

Claim Objections

7. Claims 4, 5, 9, and 18 are objected to because of the following informalities:
- a. Referring to claim 4, please correct line 4 from "immediate said instruction cannot be executed successfully for a relatively long time" to read --immediately if said instruction cannot be executed successfully for a relatively long time--
 - b. Referring to claim 5, please correct line 2 from "execution until when a signal indicates" to read --execution until ~~when~~ a signal indicates—
 - c. Referring to claim 9, please correct line 2 from "re-execute said non-reply safe" to read --re-execution said non-replay ~~reply~~ safe—
 - d. Referring to claim 18, please correct line 3 from "instructions to indicated a need for rescheduling said non-replay safe instructions" to read --instructions to indicate~~[[d]]~~ a need for rescheduling said non-replay safe instructions--
8. Appropriate correction is required.

Allowable Subject Matter

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9. Claims 2-3, 10-16, 19-23, and 26-27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 1, 4-9, and 17-18 are rejected under 35 U.S.C. 102(b) as being taught by Lotz et al., U.S. Patent Number 5,784,587 (herein referred to as Lotz).

12. Referring to claim 1, Lotz has taught a method comprising:

- a. Scheduling an instruction for execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. Speculatively executing said instruction (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- c. Determining whether said instruction executed correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);

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- d. Routing said instruction to a replay mechanism if said instruction did not execute correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- e. Determining whether a replay tornado exists (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- f. Routing said instruction for re-execution if said instruction executed incorrectly and no replay tornado exists (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and
- g. Breaking said replay tornado if said replay tornado exists, said breaking comprising:
 - i. Retiring replay safe instructions in said pipeline (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
 - ii. Marking non-replay safe instructions in said pipeline for re-execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and

- iii. Rescheduling said non-replay safe instructions for re-execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

13. In regards to Lotz, a replay tornado is defined in the specification on page 8, paragraph 0022, lines 1-2 as “a set of instructions requiring replay long after any primary cause.” The primary cause in Lotz is a cache miss by the priority instruction(s), which causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. The replay tornado of Lotz would be the priority instruction’s dependent instructions requiring a replay after the long latency cache miss has been resolved.

14. Referring to claim 4, Lotz has taught a method comprising:

- a. Scheduling an instruction for execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. Speculatively executing said instruction (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- c. Determining whether said instruction executed correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);

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- d. Routing said instruction to a replay mechanism if said instruction did not execute correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and
- e. Choosing a replay mechanism that will not put said instruction back into execution immediately if said instruction cannot be executed successfully for a relatively long time (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3)

15. In regards to Lotz, a cache miss by the priority instruction(s) causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. Lotz's dependent instructions would not be able to execute successfully until the long latency cache miss is resolved and the priority instruction(s) executed.

16. Referring to claim 5, Lotz has taught wherein an incorrectly executed instruction is not put back into execution until a signal indicates that said incorrectly executed instruction can be executed correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

17. Referring to claim 6, Lotz has taught placing said incorrectly executed instruction back into execution in a manner that will not start a tornado (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4,

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line 46 to column 5, line 7; Figure 2; and Figure 3). In regards to Lotz, a replay tornado is defined in the specification on page 8, paragraph 0022, lines 1-2 as “a set of instructions requiring replay long after any primary cause.” The primary cause in Lotz is a cache miss by the priority instruction(s), which causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. The replay tornado of Lotz would be the priority instruction’s dependent instructions requiring a replay after the long latency cache miss has been resolved.

18. Referring to claim 7, Lotz has taught

- a. Entering instructions that are not replay safe into a scheduler in program order (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. Setting a result register for each of said instructions entering said scheduler (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3), and
- c. Scheduling said instructions for execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

19. Referring to claim 8, Lotz has taught a method comprising:

- a. Storing an instruction in a queue, said queue to store a plurality of instructions and information related to each of said instructions, said information comprising a set of status bits for each of said instructions (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. Scheduling said instruction (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- c. Speculatively executing said instruction (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- d. Checking whether said instruction executed correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- e. Flagging said instruction for replay if said instruction did not execute correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- f. Determining whether a replay tornado exists and if said instruction is part of said replay tornado (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line

57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);

- g. Retiring replay safe instructions (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and
- h. Rescheduling said non-replay safe instructions for re-execution (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

20. In regards to Lotz, a replay tornado is defined in the specification on page 8, paragraph 0022, lines 1-2 as “a set of instructions requiring replay long after any primary cause.” The primary cause in Lotz is a cache miss by the priority instruction(s), which causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. The replay tornado of Lotz would be the priority instruction’s dependent instructions requiring a replay after the long latency cache miss has been resolved.

21. Referring to claim 9, Lotz has taught toggling status bits in said queue for said non-replay safe instructions to indicate need to reschedule and re-execute said non-play safe instructions (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

22. Referring to claim 17, Lotz has taught a processor comprising:

- a. A scheduler to dispatch instructions, said scheduler comprising a scheduler queue to store said instructions and a status associated to each of said instructions, said scheduler to store each instruction until that instruction is indicated to be replay safe (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. An execution unit coupled to said scheduler, said execution unit to execute said instructions (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- c. A checker coupled to said execution unit, said checker to determine whether each instruction has executed correctly (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and
- d. A replay mechanism coupled to said checker, said replay mechanism to receive an indication from said checker for each instruction that has not executed correctly, said replay mechanism further comprising logic to determine whether a replay tornado exists and whether said incorrectly executed instruction is part of said replay tornado, said replay mechanism further comprising a tornado stopping mechanism to break said replay tornado (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

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23. In regards to Lotz, a replay tornado is defined in the specification on page 8, paragraph 0022, lines 1-2 as “a set of instructions requiring replay long after any primary cause.” The primary cause in Lotz is a cache miss by the priority instruction(s), which causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. The replay tornado of Lotz would be the priority instruction’s dependent instructions requiring a replay after the long latency cache miss has been resolved.

24. Referring to claim 18, Lotz has taught logic to retire replay safe instructions in an execution pipeline, and to set statuses for said non-replay safe instructions to indicate a need for rescheduling said non-replay safe instructions (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

Claim Rejections - 35 USC § 103

25. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

26. Claims 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heuring and Jordan’s Computer Systems Design and Architecture (herein referred to as Heuring) in view of Lotz et al., U.S. Patent Number 5,784,587 (herein referred to as Lotz).

27. Referring to claims 24 and 25, Heuring has taught a system comprising:

a. A memory coupled to a bus (Heuring “The SRC Simple RISC Computer”) and

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- b. A processor coupled to said bus (Heuring “The SRC Simple RISC Computer”).
28. Heuring has not taught said processor comprising
- a. A scheduler to dispatch instructions, said scheduler comprising a scheduler queue to store said instructions and a status associated to each of said instructions, said scheduler to store each instruction until that instruction is indicated to be replay safe (Applicant’s claim 24);
 - b. An execution unit coupled to said scheduler, said execution unit to execute said instructions (Applicant’s claim 24);
 - c. A checker coupled to said execution unit, said checker to determine whether each instruction has executed correctly (Applicant’s claim 24); and
 - d. A replay mechanism coupled to said checker, said replay mechanism to receive an indication from said checker for each instruction that has not executed correctly, said replay mechanism further comprising logic to determine whether a replay tornado exists and whether said incorrectly executed instruction is part of said replay tornado, said replay mechanism further comprising a tornado stopping mechanism to break said replay tornado (Applicant’s claim 24).
 - e. Logic to retire replay safe instructions in an execution pipeline, and to set statuses for said non-replay safe instructions to indicate a need for rescheduling said non-replay safe instructions (Applicant’s claim 25).
29. Lotz has taught said processor comprising:
- a. A scheduler to dispatch instructions, said scheduler comprising a scheduler queue to store said instructions and a status associated to each of said instructions, said

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- scheduler to store each instruction until that instruction is indicated to be replay safe (Applicant's claim 24) (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- b. An execution unit coupled to said scheduler, said execution unit to execute said instructions (Applicant's claim 24) (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3);
- c. A checker coupled to said execution unit, said checker to determine whether each instruction has executed correctly (Applicant's claim 24) (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3); and
- d. A replay mechanism coupled to said checker, said replay mechanism to receive an indication from said checker for each instruction that has not executed correctly, said replay mechanism further comprising logic to determine whether a replay tornado exists and whether said incorrectly executed instruction is part of said replay tornado, said replay mechanism further comprising a tornado stopping mechanism to break said replay tornado (Applicant's claim 24) (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

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- e. Logic to retire replay safe instructions in an execution pipeline, and to set statuses for said non-replay safe instructions to indicate a need for rescheduling said non-replay safe instructions (Applicant's claim 25) (Lotz Abstract, lines 6-14; column 1, lines 12-43; column 1, line 57 to column 2, line 12; column 2, line 45 to column 4, line 31; column 4, line 46 to column 5, line 7; Figure 2; and Figure 3).

30. In regards to Lotz, a replay tornado is defined in the specification on page 8, paragraph 0022, lines 1-2 as "a set of instructions requiring replay long after any primary cause." The primary cause in Lotz is a cache miss by the priority instruction(s), which causes the dependent instructions to have to re-execute. As is known in the art, cache misses generally take a long time to recover from, since the data must be retrieved from a slower memory, such as main memory. The replay tornado of Lotz would be the priority instruction's dependent instructions requiring a replay after the long latency cache miss has been resolved. A person of ordinary skill in the art at the time the invention was made, and as supported by Lotz, would have recognized that speculating data and recovering in the method above would substantially increase instruction queue and machine performance (Lotz column 1, lines 28-29 and 46-48). Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to incorporate the device of Lotz in Heuring to increase instruction queue and machine performance.

Conclusion

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- a. Keller et al., U.S. Patent Number 5,012,403, has taught a replying mechanism.

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- b. Sager, U.S. Patent Number 5,966,544, has taught a replay mechanism.
- c. Baxter et al., U.S. Patent Number 5,944,818, has taught a restart mechanism.
- d. Merchant et al., U.S. Patent Numbers 6,094,717; 6,212,626; and 6,785,803, have taught a replay mechanism.

32. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aimee J Li whose telephone number is (703) 305-7596 or (571) 272-4169 **after 12 October 2004**. The examiner can normally be reached on M-T 7:30am-5:00pm.

33. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (703) 305-9712 or (571) 272-9712 **after 12 October 2004**. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

34. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AJL
Aimee J. Li
September 28, 2004


EDDIE CHAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100